

## SEQUENCE LISTING

<110> Schembri, Mark Andrew  
Klemm, Per

<120> Novel multifunctional adhesin proteins  
and their display in microbial cells

<130> 21352 PC 1

<150> PA 1998 00598

<151> 1998-04-30

Prov PA 60/083,794  
1998-05-01

<160> 46

<170> FastSEQ for Windows Version 3.0

<210> 1

<211> 300

<212> PRT

<213> E. coli PC31 FimH

<400> 1

Met	Lys	Arg	Val	Ile	Thr	Leu	Phe	Ala	Val	Leu	Leu	Met	Gly	Trp	Ser
1			5						10					15	
Val	Asn	Ala	Trp	Ser	Phe	Ala	Cys	Lys	Thr	Ala	Asn	Gly	Thr	Ala	Ile
	20							25					30		
Pro	Ile	Gly	Gly	Gly	Ser	Ala	Asn	Val	Tyr	Val	Asn	Leu	Ala	Pro	Val
	35						40					45			
Val	Asn	Val	Gly	Gln	Asn	Leu	Val	Val	Asp	Leu	Ser	Thr	Gln	Ile	Phe
	50					55				60					
Cys	His	Asn	Asp	Tyr	Pro	Glu	Thr	Ile	Thr	Asp	Tyr	Val	Thr	Leu	Gln
65					70					75				80	
Arg	Gly	Ser	Ala	Tyr	Gly	Gly	Val	Leu	Ser	Asn	Phe	Ser	Gly	Thr	Val
			85						90					95	
Lys	Tyr	Ser	Gly	Ser	Ser	Tyr	Pro	Phe	Pro	Thr	Thr	Ser	Glu	Thr	Pro
	100							105					110		
Arg	Val	Val	Tyr	Asn	Ser	Arg	Thr	Asp	Lys	Pro	Trp	Pro	Val	Ala	Leu
	115						120					125			
Tyr	Leu	Thr	Pro	Val	Ser	Ser	Ala	Gly	Gly	Val	Ala	Ile	Lys	Ala	Gly
	130						135					140			
Ser	Leu	Ile	Ala	Val	Leu	Ile	Leu	Arg	Gln	Thr	Asn	Asn	Tyr	Asn	Ser
145					150					155				160	
Asp	Asp	Phe	Gln	Phe	Val	Trp	Asn	Ile	Tyr	Ala	Asn	Asn	Asp	Val	Val
			165						170					175	
Val	Pro	Thr	Gly	Gly	Cys	Asp	Val	Ser	Ala	Arg	Asp	Val	Thr	Val	Thr
	180							185					190		
Leu	Pro	Asp	Tyr	Pro	Gly	Ser	Val	Pro	Ile	Pro	Leu	Thr	Val	Tyr	Cys
	195						200					205			
Ala	Lys	Ser	Gln	Asn	Leu	Gly	Tyr	Tyr	Leu	Ser	Gly	Thr	His	Ala	Asp
	210					215					220				
Ala	Gly	Asn	Ser	Ile	Phe	Thr	Asn	Thr	Ala	Ser	Phe	Ser	Pro	Ala	Gln
225					230					235				240	
Gly	Val	Gly	Val	Gln	Leu	Thr	Arg	Asn	Gly	Thr	Ile	Ile	Pro	Ala	Asn
			245						250					255	
Asn	Thr	Val	Ser	Leu	Gly	Ala	Val	Gly	Thr	Ser	Ala	Val	Ser	Leu	Gly
	260							265					270		
Leu	Thr	Ala	Asn	Tyr	Ala	Arg	Thr	Gly	Gly	Gln	Val	Thr	Ala	Gly	Asn
	275						280								



B' 12.  
con 12.

Val Gln Ser Ile Ile Gly Val Thr Phe Val Tyr Gln  
 290 295 300

<210> 2  
 <211> 7  
 <212> PRT  
 <213> Artificial Sequence  
  
 <220>  
 <221> BINDING  
 <222> 2..4  
 <223> Binding motif for binding metal oxides

<400> 2  
 His Xaa Xaa Xaa His Arg Ser  
 1 5

<210> 3  
 <211> 7  
 <212> PRT  
 <213> Artificial Sequence  
  
 <220>  
 <221> BINDING  
 <222> 2..4  
 <223> Binding motif for binding metal oxides

<400> 3  
 Arg Xaa Xaa Xaa His Arg Ser  
 1 5

<210> 4  
 <211> 7  
 <212> PRT  
 <213> Artificial Sequence  
  
 <220>  
 <221> BINDING  
 <222> 3..4  
 <223> Binding motif for binding metal oxides

<400> 4  
 Ser Lys Xaa Xaa His Arg Ser  
 1 5

<210> 5  
 <211> 7  
 <212> PRT  
 <213> Artificial Sequence  
  
 <220>  
 <221> BINDING  
 <222> 3..4  
 <223> Binding motif for binding metal oxides

<400> 5  
 Ser Arg Xaa Xaa His Arg Ser  
 1 5

<210> 6  
 <211> 7

```

<212> PRT
<213> Artificial Sequence

<220>
<221> BINDING
<222> 3..4
<223> Binding motif for binding metal oxides

<400> 6
Thr Lys Xaa Xaa His Arg Ser
1           5

<210> 7
<211> 7
<212> PRT
<213> Artificial Sequence

<220>
<221> BINDING
<222> 3..4
<223> Binding motif for binding metal oxides

<400> 7
Thr Arg Xaa Xaa His Arg Ser
1           5

<210> 8
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> Oligonucleotide for the construction of a
      double-stranded poly histidine segment (Example 1)

<400> 8
gatctcatca ccatcatcac catg
gatctcatca ccatcatcac catg
24

<210> 9
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> Oligonucleotide for the construction of a
      double-stranded poly histidine segment (Example 1)

<400> 9
gatccatggt gatgatggtg atga
gatccatggt gatgatggtg atga
24

<210> 10
<211> 54
<212> DNA
<213> Artificial Sequence

<220>
<221> unsure
<222> 13..39
<223> v indicates equal molar amounts of A, C, and G;and
      n indicates equal molar amounts of A, C, T, G in
      template oligonucleotide

```

<400> 10  
 ggacgcagat ctvnnvnnvn nvnnvnnvnn vnnvnnvnna gatctagcac cagt 54

<210> 11  
 <211> 15  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Primer oligonucleotide

<400> 11  
 actggtgcta gatct 15

<210> 12  
 <211> 13  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 12  
 Arg Ser Val Val Arg Pro Lys Ala Ala Thr Asn Arg Ser  
 1 5 10

<210> 13  
 <211> 13  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 13  
 Arg Ser Arg Ile Arg His Arg Leu Val Gly Gln Arg Ser  
 1 5 10

<210> 14  
 <211> 24  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 14  
 Arg Ser Val Lys Asp Gly Ser Ala Thr Ala Lys Arg Ser Val Ala Asn  
 1 5 10 15  
 Phe Glu Thr Pro Arg Val Arg Ser  
 20

<210> 15  
 <211> 24  
 <212> PRT  
 <213> Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 15

Arg	Ser	Ala	Pro	Gln	Thr	Gly	Arg	Pro	Asn	Asn	Arg	Ser	Leu	Pro	Leu
1				5					10					15	
Gly	Asn	Arg	Asp	Met	Gln	Arg	Ser								
			20												

&lt;210&gt; 16

&lt;211&gt; 13

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 16

Arg	Ser	Val	Gln	Asn	Asp	Arg	Ile	Val	Ala	Gly	Arg	Ser
1				5					10			

&lt;210&gt; 17

&lt;211&gt; 13

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 17

Arg	Ser	Tyr	Pro	Pro	Phe	His	Asn	Asn	Asp	His	Arg	Ser
1				5					10			

&lt;210&gt; 18

&lt;211&gt; 24

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 18

Arg	Ser	Asn	Thr	Arg	Met	Thr	Ala	Arg	Gln	His	Arg	Ser	Ala	Asn	His
1				5					10					15	
Lys	Ser	Thr	Gln	Arg	Ala	Arg	Ser								
			20												

&lt;210&gt; 19

&lt;211&gt; 24

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 19

Arg Ser Leu Ala Ile Asp Gly Thr Asp Val Gln Arg Ser Lys Pro Leu  
 1 5 10 15  
 Ala Arg Ser Ser Gly Ala Arg Ser  
 20

<210> 20  
 <211> 35  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 20  
 Arg Ser Pro Ser Pro Ile Arg Val Pro His His Arg Ser Thr Ala Ile  
 1 5 10 15  
 Pro Asn Arg Gln Leu Ile Arg Ser Gln Ile Arg Ile His Ala Met Gly  
 20 25 30  
 His Arg Ser  
 35

<210> 21  
 <211> 35  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 21  
 Arg Ser Arg Arg Val Arg Asp Ile His Leu Gly Arg Ser Val Gln His  
 1 5 10 15  
 Arg Leu Gly Gln Pro Leu Arg Ser Leu His Gln Gln Ser Ser Pro Thr  
 20 25 30  
 Leu Arg Ser  
 35

<210> 22  
 <211> 46  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 22  
 Arg Ser Arg Thr Pro Leu Ala Pro Val Pro Val Arg Ser Trp His Ile  
 1 5 10 15  
 Gly Ser Arg Thr Ile Ala Arg Ser Phe Asn Gly Ile Thr Ile Gly Asp  
 20 25 30  
 Asn Arg Ser Tyr Ile Pro Glu His Trp Tyr Trp Ser Arg Ser  
 35 40 45

<210> 23  
 <211> 13  
 <212> PRT  
 <213> Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 23

Arg	Ser	Gly	Arg	Met	Gln	Arg	Arg	Val	Ala	His	Arg	Ser
1				5					10			

&lt;210&gt; 24

&lt;211&gt; 13

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 24

Arg	Ser	Leu	Gly	Lys	Asp	Arg	Pro	His	Phe	His	Arg	Ser
1				5					10			

&lt;210&gt; 25

&lt;211&gt; 24

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 25

Arg	Ser	Arg	Gly	Leu	Arg	Asn	Ile	Leu	Met	Leu	Arg	Ser	Tyr	Asp	Ser
1				5					10					15	
Arg	Ser	Met	Arg	Pro	His	Arg	Ser								
				20											

&lt;210&gt; 26

&lt;211&gt; 24

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 26

Arg	Ser	Glu	Pro	Arg	Arg	Ala	Thr	Gln	Ala	Pro	Arg	Ser	Lys	Pro	Gln
1				5					10					15	
Lys	Asn	Glu	Pro	Ala	Pro	Arg	Ser								
				20											

&lt;210&gt; 27

&lt;211&gt; 35

&lt;212&gt; PRT

&lt;213&gt; Artificial Sequence

&lt;220&gt;

<223> Sequence conferring the ability of cells to adhere  
to metal oxides

&lt;400&gt; 27

Arg Ser Leu Gly Ala Val Ser Ser Leu Phe Ser Arg Ser Gln Lys Ile  
 1 5 10 15  
 Met Gln Thr Asp Ile Val Arg Ser Lys Gly Val Arg Pro Gly Ala Gln  
 20 25 30  
 Arg Arg Ser  
 35

<210> 28  
 <211> 13  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 28  
 Arg Ser His His Met Leu Arg Arg Arg Asn Thr Arg Ser  
 1 5 10

<210> 29  
 <211> 13  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 29  
 Arg Ser His Ile Asn Ala Ser Gln Arg Val Ala Arg Ser  
 1 5 10

<210> 30  
 <211> 24  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 30  
 Arg Ser Cys Pro Arg Leu Gly Val Trp Phe Tyr Arg Ser Leu Ser Val  
 1 5 10 15  
 Gly Asp Gly Phe Val Arg Arg Ser  
 20

<210> 31  
 <211> 35  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to metal oxides

<400> 31  
 Arg Ser Thr Ser Gly Pro Ser Arg Val Met Thr Arg Ser Ile Ile Leu  
 1 5 10 15  
 Arg Ile Gly Thr Leu Asp Arg Ser Cys Leu Lys Val Phe His Met Gly



Trp Arg Ser 20 25 30  
35

<210> 32  
<211> 35  
<212> PRT  
<213> Artificial Sequence

<220>  
<223> Sequence conferring the ability of cells to adhere  
to metal oxides

<400> 32  
Arg Ser Ile Thr Pro Ile Leu His Asp His Arg Arg Ser Ser Val Arg  
1 5 10 15  
Pro Met Val Ala His Arg Arg Ser Pro Thr Leu Tyr Phe Pro Ala Ala  
20 25 30  
Ser Arg Ser  
35

<210> 33  
<211> 6  
<212> PRT  
<213> Artificial Sequence

<220>  
<221> BINDING  
<222> 3..4  
<223> Binding motif for binding metal oxides

<400> 33  
Ser Lys Xaa Xaa Ala Arg  
1 5

<210> 34  
<211> 6  
<212> PRT  
<213> Artificial Sequence

<220>  
<221> BINDING  
<222> 3..4  
<223> Binding motif for binding metal oxides

<400> 34  
Ser Arg Xaa Xaa Ala Arg  
1 5

<210> 35  
<211> 6  
<212> PRT  
<213> Artificial Sequence

<220>  
<221> BINDING  
<222> 3..4  
<223> Binding motif for binding metal oxides

<400> 35  
Thr Lys Xaa Xaa Ala Arg  
1 5

<210> 36  
 <211> 6  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <221> BINDING  
 <222> 3..4  
 <223> Binding motif for binding metal oxides

<400> 36  
 Thr Arg Xaa Xaa Ala Arg  
 1 5

<210> 37  
 <211> 7  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <221> BINDING  
 <222> 3..4  
 <223> Binding motif for binding metal oxides

<400> 37  
 Arg Xaa Xaa Xaa His Arg Ser  
 1 5

<210> 38  
 <211> 24  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to ZnO

<400> 38  
 Arg Ser Asn Thr Arg Met Thr Ala Arg Gln His Arg Ser Ala Asn His  
 1 5 10 15  
 Lys Ser Thr Gln Arg Ala Arg Ser  
 20

<210> 39  
 <211> 24  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to ZnO

<400> 39  
 Arg Ser Val Phe Leu Pro Ser Ile Leu Gly Trp Arg Ser Arg Leu Asp  
 1 5 10 15  
 Asp Gln Gly Val Ala Ala Arg Ser  
 20

<210> 40  
 <211> 24

<212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to ZnO

<400> 40  
 Arg Ser Thr Arg Asn Lys His Thr Thr Ala Arg Arg Ser Val Ala Pro  
 1 5 10 15  
 Gly Ile Gly Glu Pro Ser Arg Ser  
 20

<210> 41  
 <211> 24  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to ZnO

<400> 41  
 Arg Ser Ile Met His Val Arg Leu Arg Ala Arg Arg Ser Ala Arg His  
 1 5 10 15  
 Met Lys Asp Ala Asp Pro Arg Ser  
 20

<210> 42  
 <211> 24  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to ZnO

<400> 42  
 Arg Ser Pro Ile Ile Ile Arg Ser Arg Ile Asn Arg Ser His Gly Arg  
 1 5 10 15  
 Thr Lys Ala Thr Pro Ala Arg Ser  
 20

<210> 43  
 <211> 24  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Sequence conferring the ability of cells to adhere  
 to ZnO

<400> 43  
 Arg Ser Arg Gly Leu Arg Asn Ile Leu Met Leu Arg Ser Tyr Asp Ser  
 1 5 10 15  
 Arg Ser Met Arg Pro His Arg Ser  
 20

<210> 44  
 <211> 13  
 <212> PRT

<213> Artificial Sequence

<220>

<223> Sequence conferring the ability of cells to adhere  
to ZnO

<400> 44

Arg Ser Thr Arg Arg Gly Thr His Asn Lys Asp Arg Ser  
1 5 10

<210> 45

<211> 14

<212> PRT

<213> Artificial Sequence

<220>

<223> Sequence conferring the ability of cells to adhere  
to ZnO

<400> 45

Arg Ser Thr Val Pro Lys Lys Arg His Pro Lys Asp Arg Ser  
1 5 10

<210> 46

<211> 13

<212> PRT

<213> Artificial Sequence

<220>

<223> Sequence conferring the ability of cells to adhere  
to ZnO

<400> 46

Arg Ser Tyr Asp Ser Arg Ser Met Arg Pro His Arg Ser  
1 5 10

B'  
concl'n.